



Anomalous L2 rejections

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- Symptoms of the problem:
 - where and how was it found?
 - trigger mask data path
- Data integrity
 - L2 software/hardware checks
 - further cross checks
- Future (new) monitoring
- Data quality and conclusions





L1/L2 bit mask

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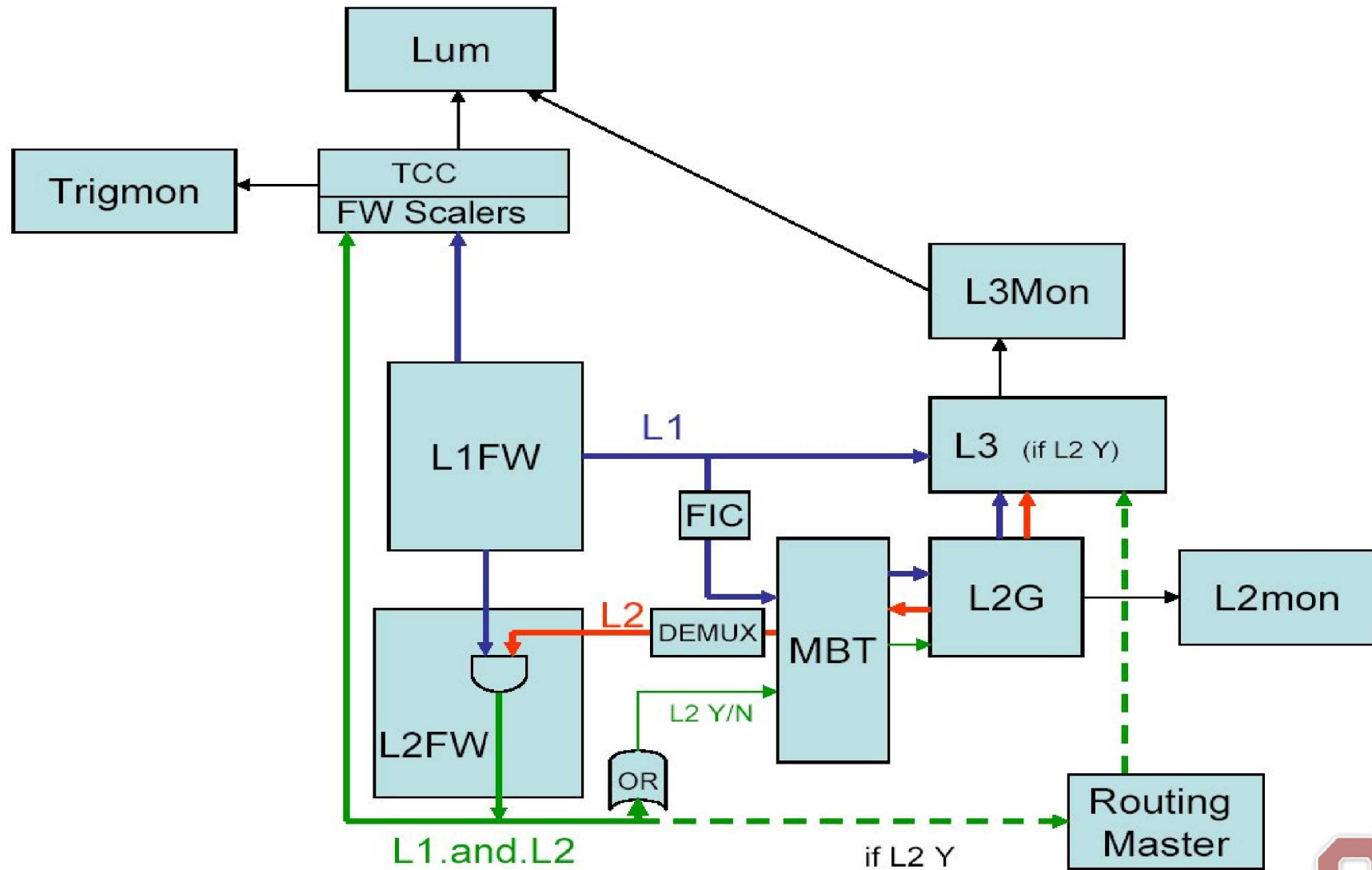
- When was the problem found?
 - when v13 was put on-line:
 - bit 009 with L2 rejection ~26 when it only 2-3 was expected
 - bit 057 with L2 rejection 2.4 when 1.0 was expected (no L2 conditions)
 - 1st "bad" run: 192823, 1st "good" run: 194598
- Where was it found?
 - run **luminosity reports** (not only v13, but when older luminosity reports were checked, this problem has been around for a while in v12, too)
 - Trigger Meisters: `daqdialog/l2mon`
 - BUT all three programs look at the SAME numbers (L1 scalers) so they did not give us any new information





Bit mask - path

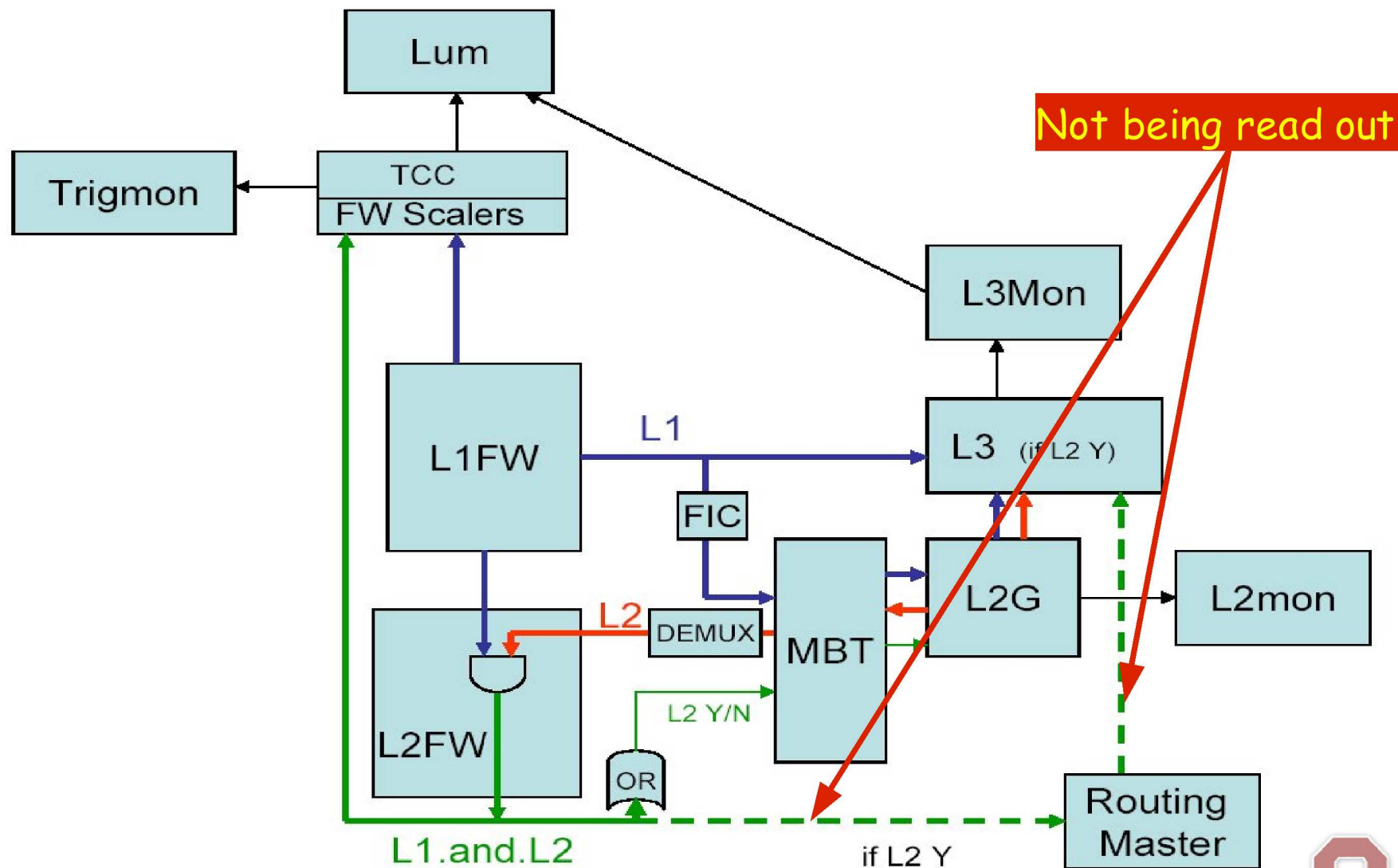
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Bit mask - path

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Bit mask - monitoring

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- Problem appeared on May 9, when L2GBL's pilot MBT was replaced due to its malfunctioning (trigger v12)
- On June 29, this MBT was replaced
 - how could we monitor/recognize it?
 - check the **luminosity reports** - rather off-line monitoring created one-two days after the run was taken
 - or, stare at the **l2mon** screen
 - or, monitor triggers with no L2 restrictions \Rightarrow **trigstripmon** - but must know which ones and must know the base line - this is on-line monitoring





L2 faulty MBT

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- MBT - hardware:
 - 128 bit L2 answer comes out of the MBT in eight 16 bit words (sent out sequentially from the same driver)
 - MBT bit 9 of 16
broken differential pair - 6 $M\Omega$ instead of expected 130 Ω to ground
affects L2 answer bits 9, 25, 41, 57, 73, 89 and 105
 - Results:
sometimes reports "reject" (FALSE) instead of "accept" (TRUE)
it seems that this happens when the neighboring bit is set to TRUE
(logic levels are inverted)
- = faulty MBT

Output goes ONLY to HFW and luminosity scalers, but NOT to L3





L2 software

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- L2 code:
 - “OR” of all L2 trigger bits must agree with L1 TFW
 - disagreement would raise an error, stop the data flow and request SCL-init
 - this is fully automated - daqAI
 - it could be unnoticed - if it happens “frequently”, DAQ shifter would notice and alarm L2 experts
 - going through all L2 log files, this happened only 2 times between May 9 and June 28/29
 - This check was/is/will be working before/during/after the incident
 - L2 GBL bits written to tape are NOT affected by the MBT



Symptoms (from lumi reports)

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- Luminosity reports give L3 trigger names
- Total of 308 runs with this hardware configuration (+ 24 runs when L3 trigger names were on L1 bits 10, 26, etc. ...)

bit #	L1 name	L3 name
009	CEM(1,11)_ncu ²	E1_ELE_MP, E1_SHT20, E1_SH30, E1_L50, E1_VL70, E1_SHT15_M15, E1_L20_M25, E1_SHT15_TK13, E1_T7SHT8_2TK5, E1_T7SHT8_M10, E1_T13L15, E1_T25VL30, E1_2L20, E1_2SH8, E1_2L15_SH15, E1_2L8_T8L8, E1_SHT15_2J20, E1_SH15_2J20_M10, E1_SHT15_2J_HT50
025	CJT(3,5)_ncu ⁴	MHT20_L2L0_PVZ
041	mu1ptxwtxx_ncu ²	MU_W_L2M3_L3L15 (?)
057	mu1pt4wlxx_CJT(1,3)_ncu	... never fired ...
073	mu2ptxatxx_ncu	mu2ptxatxx
089	mu2ptxcllxmu1ptxctlx_ncu ³	2MU_C_2L2_2TRK
105	ALMSouth[v]ALMNorth[v]_ncu	zero_bias_GapSN_NCU

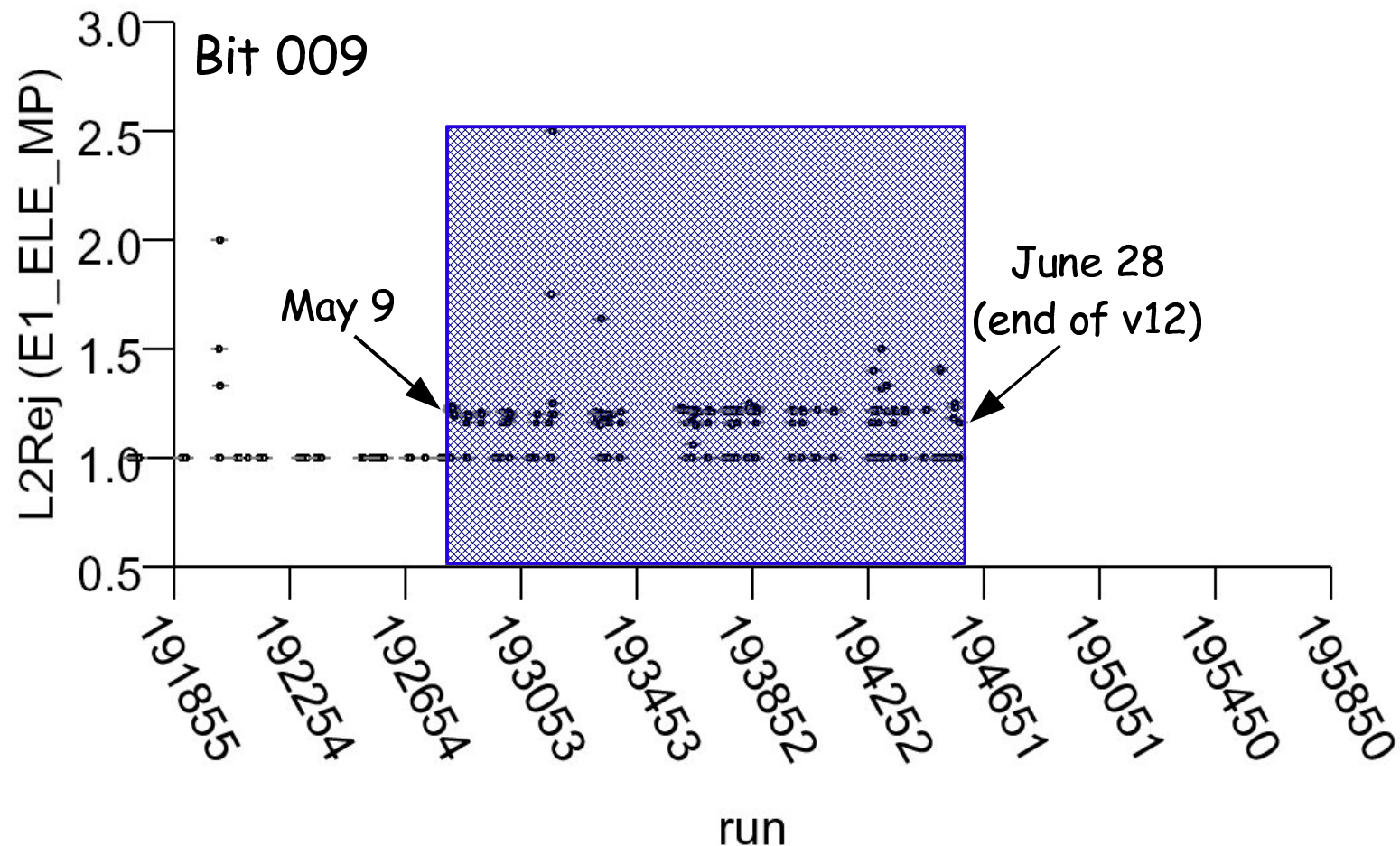




Symptoms (from lumi reports)

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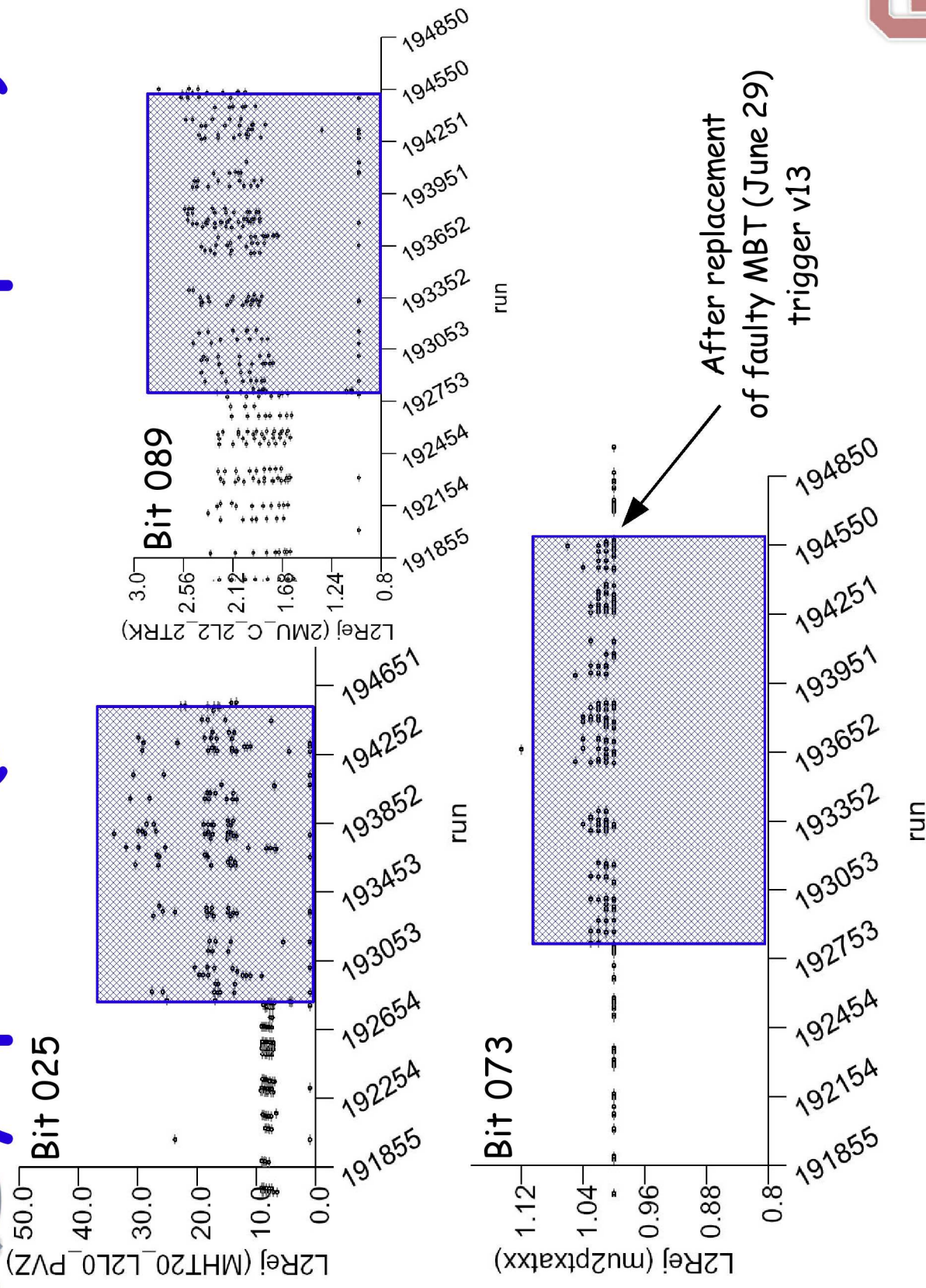
- What do we see from luminosity reports?





Symptoms (from lumi reports)

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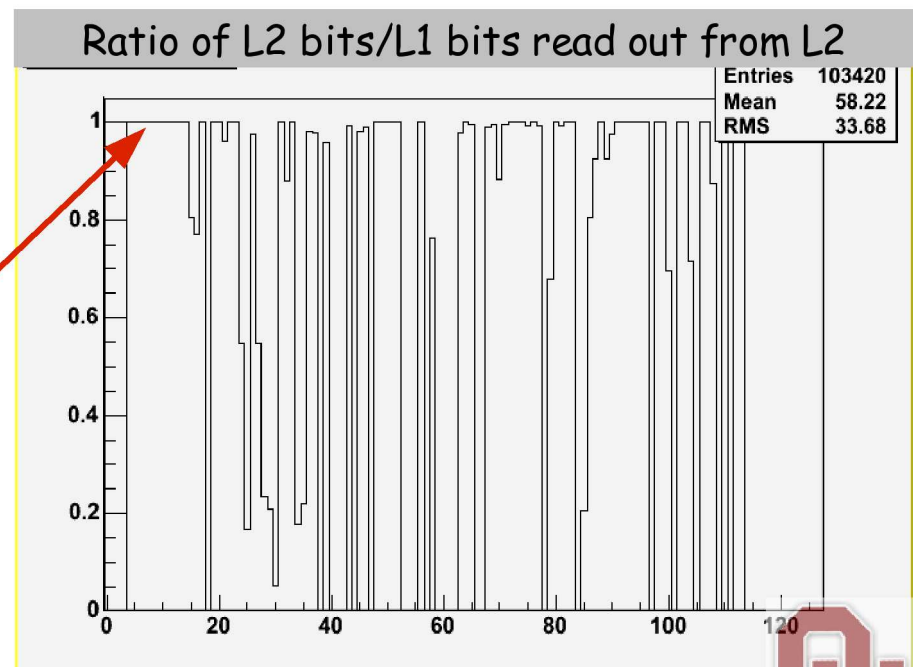
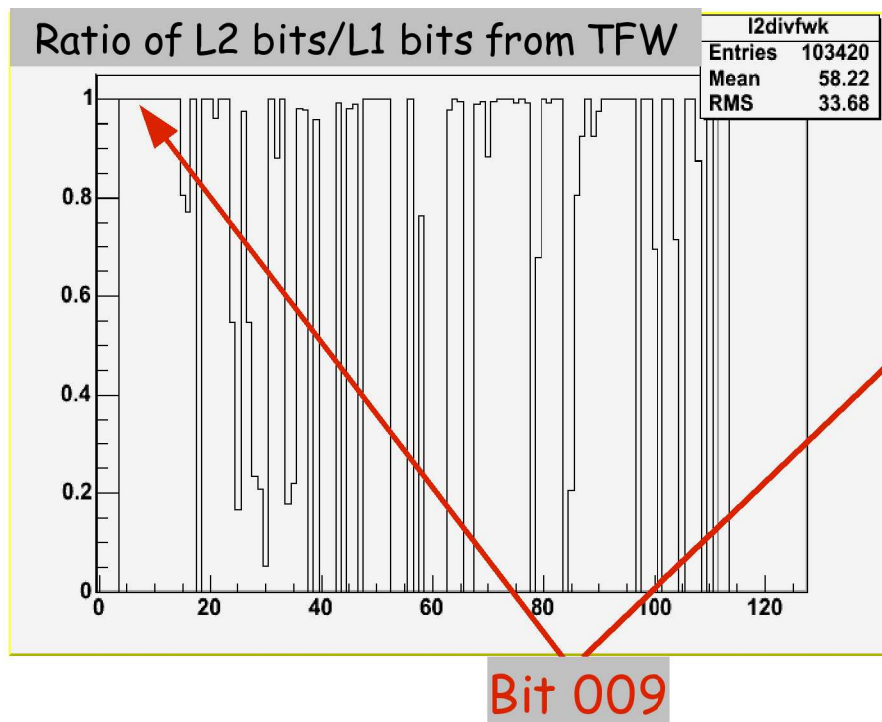




Cross check of L1/L2 masks on tape

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- Check the trigger masks off-line using the monitor stream (and also all data stream)
- If there was extra L2 rejection, it should be observed (run 192823, by Bob Hirosky)





Cross checks – data quality

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- **Test № 1:**
 - test single bits - use zero_bias triggers on each bit, firing at L2 with 50% probability
 - bit 9 of the bad MBT behaved normally, no extra L2 rejection was observed
- **Test № 2:**
 - if L1TWF "OR" does not agree with L2 "OR", L2 must complain
 - Dan Edmunds set an L1TWF bit off after L2 received the trigger mask
⇒ L2 reacted correctly ⇒ L2 raised an error and requested SCL-init
 - this worked with both, bad and good, MBTs as expected
- **No L2 software changes during this period of time!**
- Bit mask consistency check works ⇒ L2 monitoring seen in the luminosity reports is wrong

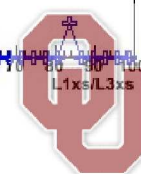
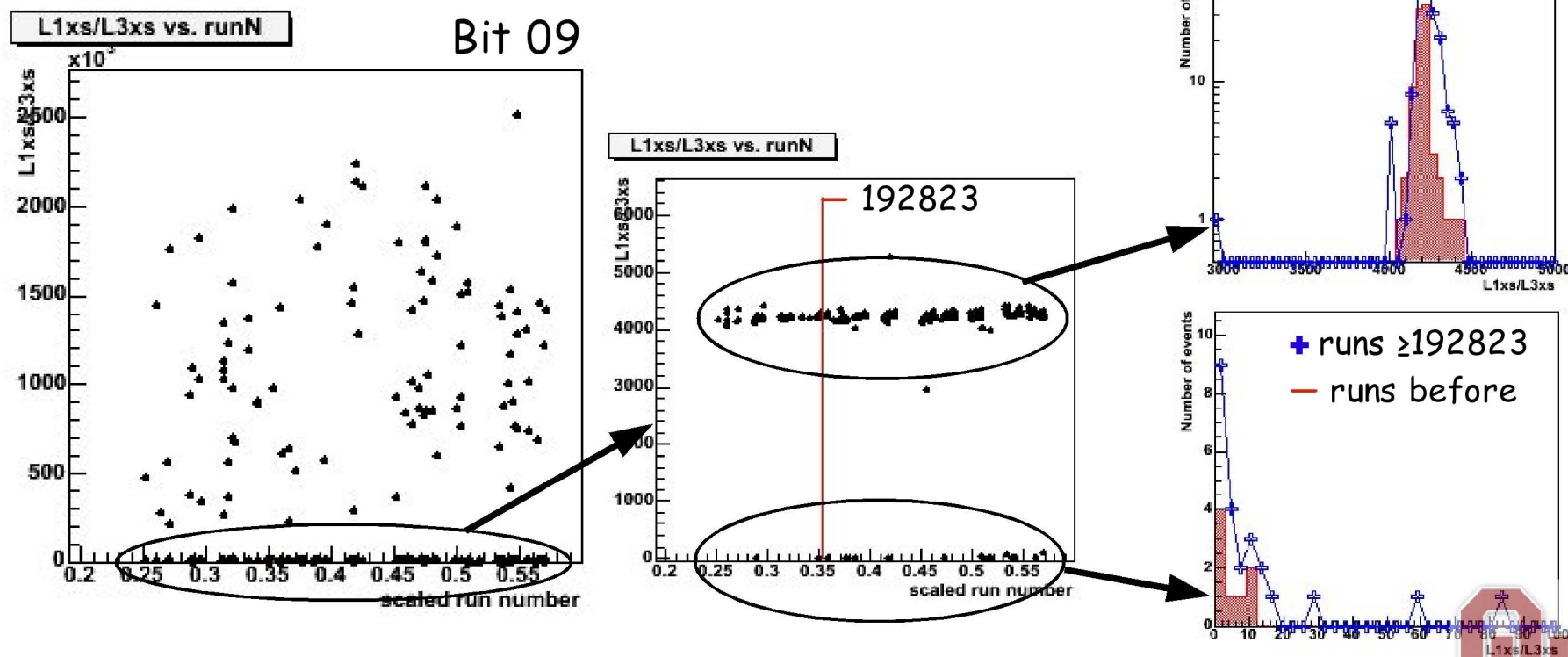




More cross checks ...

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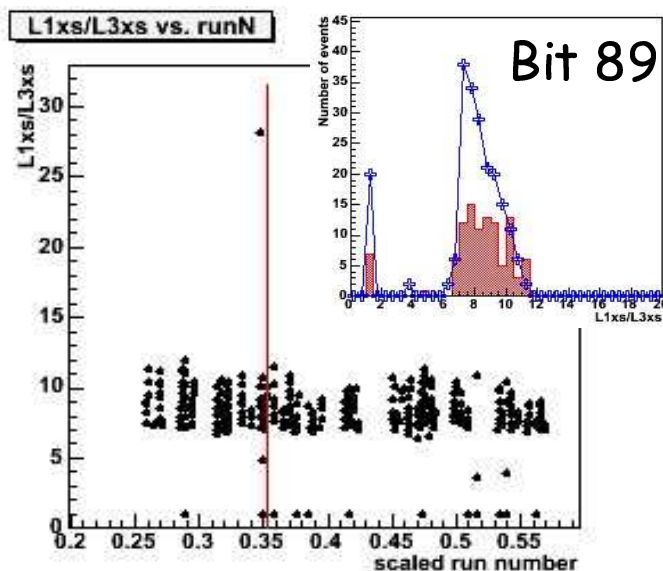
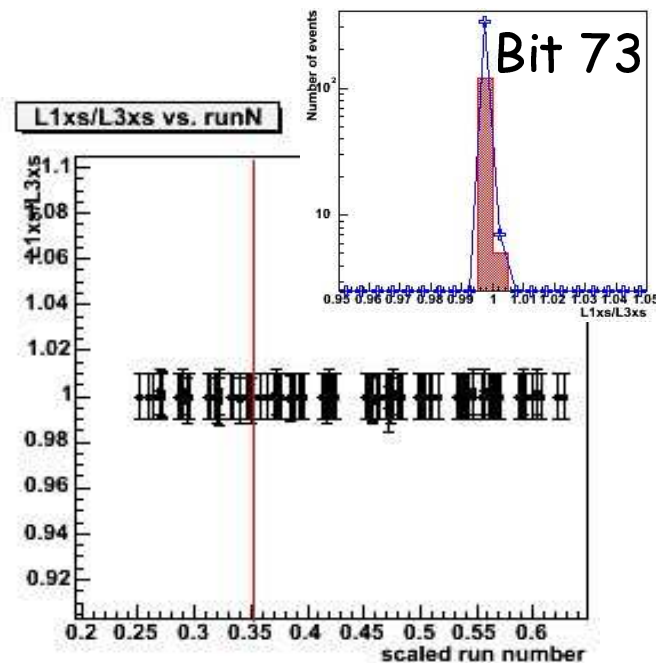
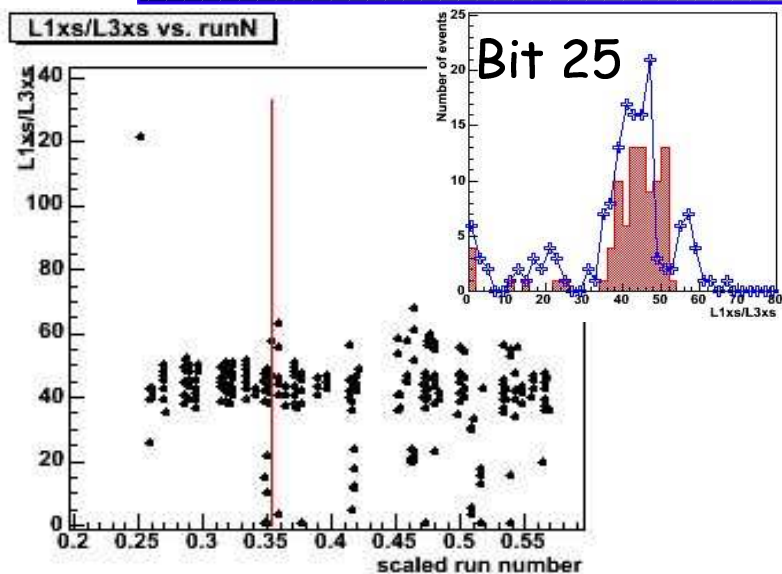
- Using luminosity report data, we looked at $L1xs/L3xs$ ratio and $L1xs/L2xs$ ratio
- No difference has been observed in runs taken **before** and **after** May 9 (run 192823):





More cross checks (xs: L1/L3)

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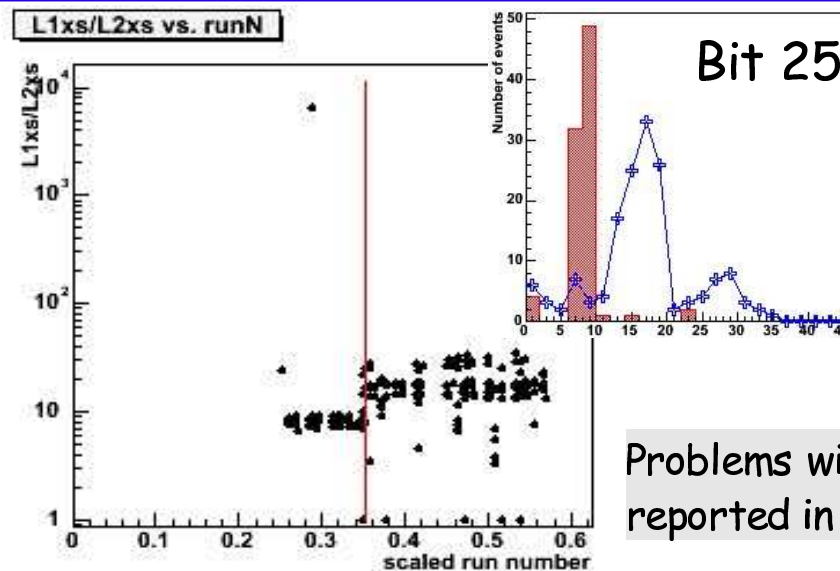
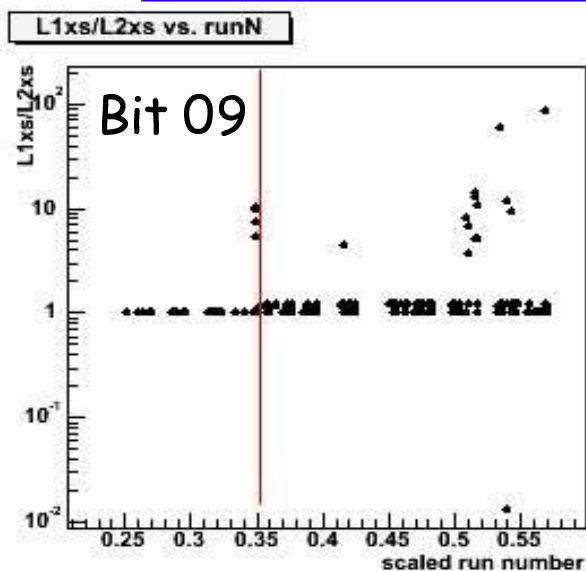
No problems with L3
numbers reported in
lumi



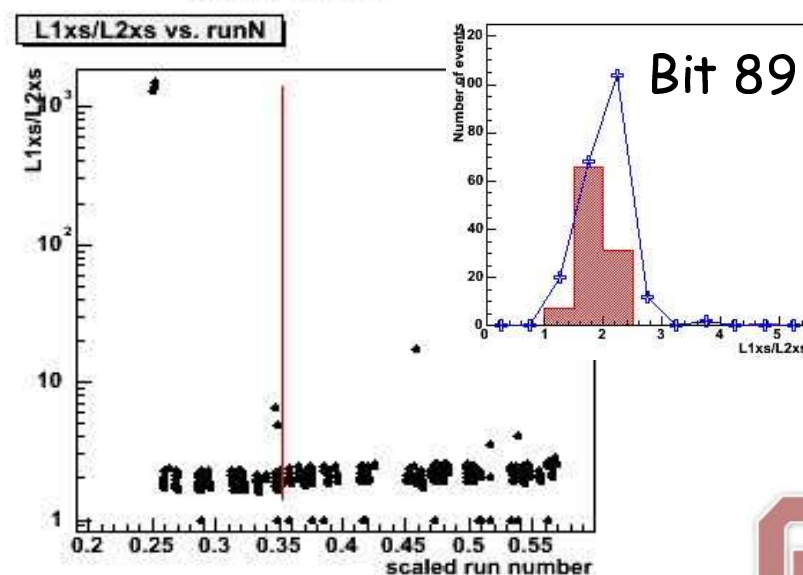
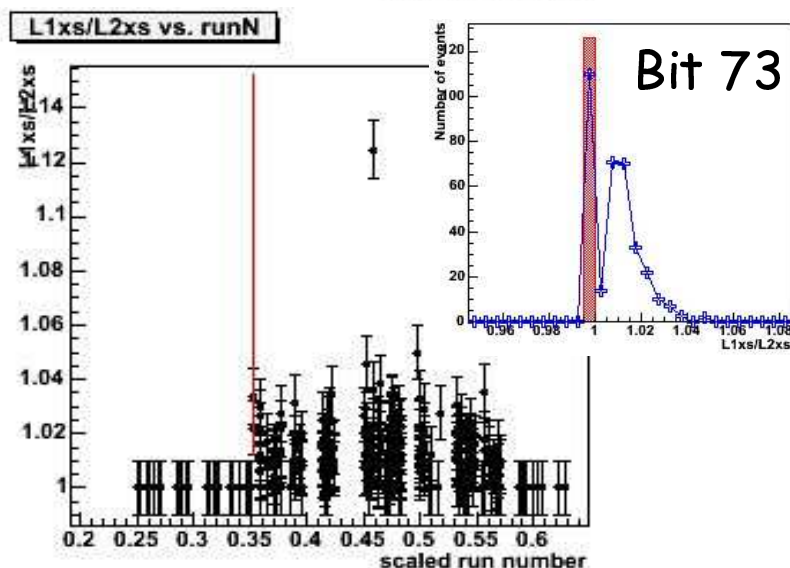


More cross checks (xs: L1/L2)

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Problems with L2 numbers reported in lumi





Future (new) monitoring

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- L3 monitoring crate - compare L2 trigger masks:
 - compare L1 x L2 (**green**) with L1 x L3 (**red** x **blue**) from L2 GBL in L3
 - compare L1 (**blue** from L1) with L1 (**blue** from L2 GBL) in L3





Conclusions

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- Problem was observed in at least two different places:
 - luminosity reports
 - l2mon/daqdialog
- Both monitors are based on the same L1 scaler numbers
- Faulty MBT - current model - only bit 9 has wrong resistance but failure appears based on cross talk within the bit mask
- This problem does not make luminosity blocks bad





L2 decisions are correct!

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- If "OR" of L2 bit mask does not agree with "OR" of TWF bit mask, L2 raises an error - this check is working and does not fail
- L2 and L3 decisions are unaffected by this L2 problem
 - check with luminosity scalers for L1 and L3 XS and there is no change!
- Data quality
 - no discontinuity at L3, no problems with the data \Rightarrow **data is all GOOD!**
 - the only precaution must be taken when studying L2 trigger efficiencies for affected bits - change in DB
 - L2 mask on tape is correct (because MBT is out of the path)





More cross checks ...

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- What was the unique rate?

(rate of a group of triggers when all other triggers do not fire)

- trigger configuration was such as to prevent bits 9, 25, ... from being the only triggers which fired at L2
- however, L3 triggers grouped to L2 bits do have a unique rates
- **no difference** for bits 9, 25, ... in L3 trigger group rates before and after May 9

Group_L2bit009	44288	0.119	4.366	0.169	0.74	E3_SHT20	0.322
Group_L2bit025	14514	0.039	1.431	0.570	0.82	MHT30_3CJT5	0.172
Group_L2bit041	9178	0.025	0.905	0.010	0.01	MUW_W_L2M3_TRK10	0.961
Group_L2bit073	999	0.003	0.098	0.565	0.06	2MU_A_L2M0	0.428
Group_L2bit089	10585	0.029	1.044	0.503	0.53	MUW_L2M0_2TK3_MM	0.231
Group_L2bit105	174	0.000	0.017	1.000	0.02	none	0.000
Trigger Name	# of events	bandwidth fraction	rate to tape (Hz)	unique fraction	unique rate to tape (Hz)	largest overlap with trigger	largest overlap

